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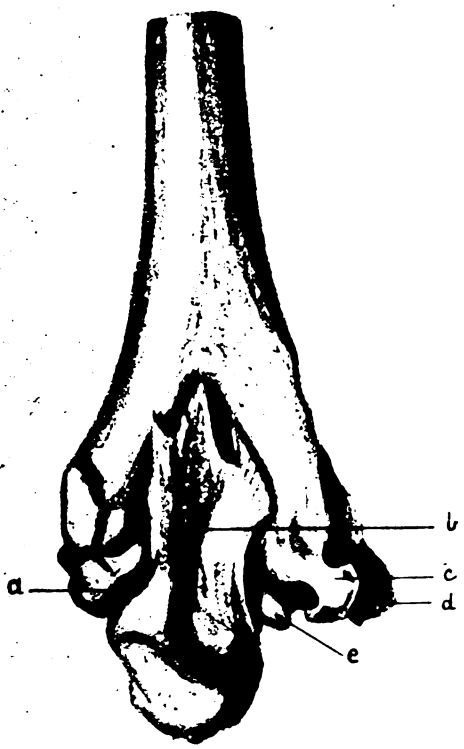

Fig. I.

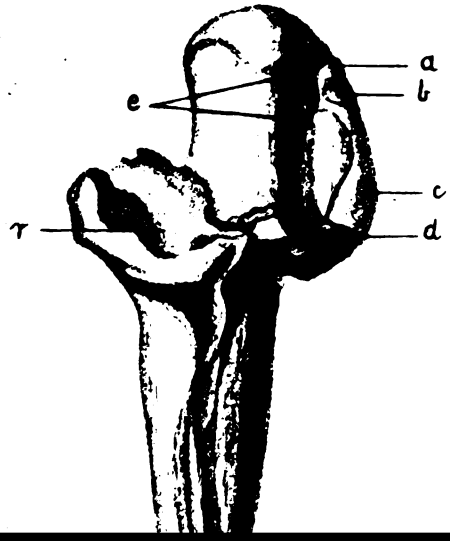

Fig. III.

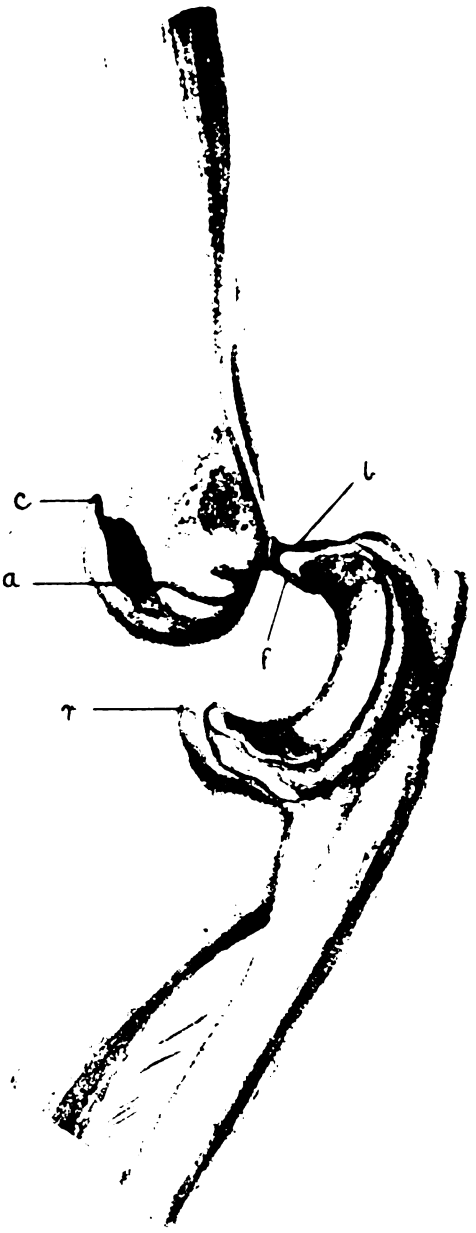

Fig. II.

Fig. IV.

Fractures of the elbow-joint

Walter Ela

Dr. H. P. Quincy Del.

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E. Bierstadt's Albertype, N. Y.

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FRACTURES OF THE ELBOW-JOINT.

AN ESSAY

TO WHICH WAS AWARDED THE SECOND PRIZE OF THE BOYLSTON MEDICAL SOCIETY FOR 1873.

BY

WALTER ELA.

CAMBRIDGE:
WELCH, BIGELOW, AND COMPANY,
University Press.
1873.

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By the kindness of Drs. J. T. Heard and C. B. Porter I obtained most of my statistics from the fracture books of the Out-Patients Department of the Massachusetts General Hospital.

The drawings from which the woodcuts and albertype were taken were made by Dr. H. P. Quincy.

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FRACTURES OF THE ELBOW-JOINT.

Fractures of the elbow-joint, in most surgical works, receive scarcely more than a passing notice. In two essays on fractures of the upper extremity that I have seen lately, fractures at the elbow have been ignored. The joint is a valuable one, and the proper treatment in case of fracture is important. In unskilful hands, they readily pass for sprains, which upon casual inspection they closely resemble, and are treated accordingly.

The diagnosis as to the nature of the fracture is not always easily made out, even by skilful surgeons. The obscurity which attends fractures in this region is due to the facts: that the bones are beneath a great mass of muscle; that the important structures are confined in so small a compass; that œdema, often accompanied by ecchymosis, speedily ensues on account of the laxity and mobility of the parts; that an effusion often takes place rapidly within the artic-

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ulation; and that, owing to the similarity of symptoms, it is sometimes difficult to determine whether we have to deal with a fracture or with a dislocation.

Surgeons confess that among the most difficult fractures to treat successfully are to be classed those of the elbow-joint. This difficulty is due chiefly to the implication of the joint. The treatment is not varied, inasmuch as all fractures in this region, with one exception, are treated in the same manner. Even if a correct diagnosis is made, and the appropriate treatment pursued, we are not always confident that there will be a happy result. The uncertainty in prognosis is, to a great extent, due to the extensive articular surfaces in this vicinity, which are often implicated in case of fracture of the joint, whereby inflammation is set up, and this is followed by a fibrinous exudation and proliferation of cells, resulting in firm adhesions, causing anchylosis, and seriously impairing the use of the joint.

The injury is not infrequently of a complicated nature: instead of a simple fracture, there may be a dislocation with one or more fractures, a compound fracture, a comminuted fracture, or both.

An accurate knowledge of the anatomy of the parts is essential to understand the fractures which occur at this articulation.

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Anatomy of the Joint.

The lower extremity of the humerus, the upper extremities of the radius and ulna, form this joint. The humerus is expanded laterally into the external and internal condyles, the latter of which is the more prominent. Between these condyles are the articulating surfaces for the radius and ulna. The articular surface on which the head of the radius is received, the capitellum, is on the inferior extremity of the external condyle. That for the ulna, the trochlea, is much broader, and extends from the coronoid fossa anteriorly to the olecranon fossa posteriorly. The partition of bone between these fossæ is very thin, — so thin that in some cases they meet, and the *supratrochlear* foramen is formed, which frequently exists in the Mound Builders and in some of the lower mammalia. The *supracondylar* foramen is above the internal condyle, but does not exist in man normally. This it is which transmits the median nerve and brachial artery when these structures deviate from their usual course.

The upper extremity of the ulna has, anteriorly to the greater sigmoid articular surface, the coronoid process, into the base of which is inserted a portion of the brachialis anticus. Posteriorly to the greater sigmoid cavity is the olecranon, which forms the

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point of the elbow, and into which is inserted the triceps extensor cubiti. In flexion, the coronoid process is received into the coronoid fossa; and in extension, the olecranon process into the olecranon fossa. On the radial side of the coronoid process, the radius finds an articular cavity, — the lesser sigmoid cavity.

The head or superior extremity of the radius is disk-shaped, and concave at its extremity. It is supported on a constricted portion, of a cylindrical form, called the neck. About an inch and three eighths below the head is the tubercle into which is inserted the tendon of the biceps.

Ligaments.

The ligaments which bind these bones together are the external and internal lateral, the orbicular, the anterior, the posterior, and the oblique.

In all ginglymoid joints like the elbow, the lateral ligaments are the strongest.

The external lateral ligament arises from the external condyle, and is inserted chiefly into the orbicular ligament.

The internal lateral ligament is composed of an anterior and posterior part, which have a common origin from an eminence on the internal condyle.

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The anterior set radiate and are inserted along the inner margin of the greater sigmoid cavity. The posterior set, of a similar triangular shape, are chiefly inserted into the inner border of the olecranon.

A band of lateral fibres extends from the coronoid process to the olecranon, so that when the latter is fractured, it is this ligament, in some cases, which prevents its extensive separation.

The orbicular ligament passes from the ulna anteriorly to the lesser sigmoid cavity posteriorly, surrounding the head of the radius. This ligament does not adhere to the radius, as it is lined by the synovial membrane of the elbow-joint, which is reflected beneath, in a thin sheet, upon the inferior border of the head of the radius.

The anterior and posterior ligaments are thin, loose fibres, which arise just above the fossæ on the anterior and posterior aspects of the humerus. The anterior is inserted into the coronoid process and orbicular ligament; the posterior, into the olecranon.

These with the lateral ligaments form the capsule of the joint.

The oblique ligament passes downwards and outwards from the coronoid process of the ulna to just below the tubercle of the radius; and it is this ligament which limits the rotation of the radius.

The synovial membrane is very extensive; it lines

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the olecranon and coronoid fossæ; from these points it is reflected over the anterior, posterior, and lateral ligaments, and forms a pouch between the lesser sigmoid cavity, the inner surface of the orbicular ligament, and the circumference of the head of the radius.

Muscles.

The brachialis anticus passes over the anterior part of the condyles and the capsular ligament, to which it is attached, and is inserted into the base of the coronoid process and into the body of the ulna just below. It flexes the forearm, and strengthens the capsular ligament.

The triceps descends, and is inserted by a broad tendon into the upper posterior surface of the olecranon.

The anconeus, really a continuation of the above, arises by a tendon from the posterior part of the external condyle, and is inserted into the radial side of the olecranon and the adjacent surface of the ulna. The muscles last named are extensors of the arm.

The biceps is inserted by a tendon into the tubercle of the radius. Its tendinous expansion towards the internal condyle is the aponeurosis, which gives rise in part to the internal group of flexors and prona-

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tors of the forearm. This muscle bends the forearm and rotates the radius outwards, that is, supinates the hand.

From the internal condyle arise the flexors and pronators of the forearm, whose muscular fibres, in general, pass anteriorly downwards and a little inwards. From the external condyle arise the extensors and supinators. The supinator longus, supinator brevis, and extensor carpi radialis longior pass downwards anteriorly, while the rest pass downwards posteriorly.

Inasmuch as the parts to which we are to turn our attention are of slow growth, some of them not being developed until puberty, and inasmuch as very many fractures in this region occur before that age, it may be well to consider briefly the development of the bones.

Development of the Bones.

The development of the lower end of the humerus begins with one cartilaginous centre for the shaft, one for the external, one for the internal condyle, one for the capitellum, and one for the trochlea.

At the end of the second year ossification commences in the radial portion of the articular surface, and from this point extends inwards, so as to form the chief part of the articular end of the bone, the centre

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for the inner part of the articular surface not appearing until about the twelfth year.

Ossification commences in the internal condyle about the fifth year, and in the external one not until between the thirteenth and fourteenth years.

The trochlea, capitellum, and external condyle unite with the shaft between the sixteenth and seventeenth years.

The internal condyle unites with the shaft about the eighteenth year.

The development of the superior extremity of the ulna takes place from two centres, one for the shaft and coronoid apophysis, the other for the olecranon. Ossification commences near the middle of the shaft about the fifth week, and soon extends through the greater part of the bone. Ossification commences in the olecranon near its extremity about the tenth year, and at about the sixteenth year this upper epiphysis is joined to the shaft.

The development of the superior extremity of the radius, also, takes place from two centres, one for the shaft, the other for the head of the bone. At birth the shaft is ossified. Ossification commences in the upper epiphysis about the fifth year, and this is joined to the shaft about puberty.

In the consideration of the fractures of the elbow-joint, we will point out the nature of the fractures,

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their frequency, causes, complications, diagnosis, mode of union, treatment, and prognosis.

In Holmes's "Surgery" it is stated that the humerus is more frequently fractured at the shaft than at either extremity, and the statistics of Mr. Lonsdale seem to confirm this view; of 118 fractures of the humerus, he found that 89 were of the shaft and 16 of the condyles.

Amesbury, Ferguson, B. Cooper, and others say that this bone is most often broken at its middle third.

On the other hand, Hamilton found in 113 fractures of the humerus, 42 in the upper and middle thirds, and 71 in the lower third.

In the Berlin Hospital, of 194 cases, 48 were of the upper extremity, 62 in the middle, and 84 at the lower extremity of the humerus. Of these 153 were males.*

According to the fracture books of the Out-Patients Department, for the last four and one third years, there were 375 fractures of the upper extremity; of these 17 were in the upper two thirds; 73 in the lower part of the humerus; and, in all, 87 in the neighborhood of the elbow-joint.

Fractures of the lower end of the humerus are divided by Holmes into two classes: one, those

* Gurlt's "Knockenbrüchen," Vol. II. p. 653.

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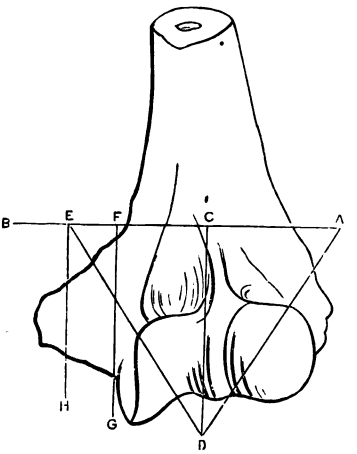
which are external to the joint, and which do not implicate the synovial membrane. Examples of this class are fractures just above the condyles, separation of the lower epiphysis, and fracture of the internal epicondyle. The other class comprises those which are directly connected with the joint and synovial membrane, to wit: a transverse fracture of the lower end of the humerus, with a vertical fissure extending through the lower fragment which separates the condyles from each other and from the shaft; in fine, making a T-shaped fracture into the joint; it also comprises fractures, vertical or oblique, of one or both condyles extending into the articulation.

Diagram to show the Fractures at the lower Extremity of a left Humerus.



I. AB = Fracture of the base of the condyles.
II. ABCD = A T-shaped fracture into the joint.
III. ED = Fracture of internal condyle entering the joint.
IV. FG = Fracture of internal condyle without entering the joint.
V. EH = Fracture of internal epicondyle.
VI. AD = Fracture of external condyle.

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It is a fact worthy of remark, that the fractures of this joint are especially common in childhood, before the epiphyses have united.

At the lower end of the humerus, there are six fractures,—seven, if we include that of the external epicondyle, the fracture of which has never been made out, as it is so exceedingly small.

I. Fracture at the base of the condyles may be transverse, or oblique forwards or backwards; usually it is oblique from before upwards. The amount of deformity depends on the direction of the line of fracture. If transverse, which it is very rarely, the biceps and triceps antagonize each other, and but little deformity results. If oblique, however, the powerful muscles cause a shortening and riding of the fragments. When the usual fracture takes place, the lower fragment is drawn upwards and backwards by the triceps; the upper fragment downwards and forwards by the biceps and brachialis anticus.

The ends of the bones, being thus drawn, simulate dislocation of the radius and ulna backwards. Dupuytren says, "there is nothing so common as mistaking this fracture for the above-named dislocation." A careful comparison of the phenomena which these injuries present will aid in the diagnosis.

In case of fracture will be noticed,—First, a shortening of the humerus, as is seen by measuring from

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the acromion process of the scapula to the internal condyle, and comparing the injured with the sound arm. Secondly, crepitus, which can often be detected on extending the arm, or on rotating the forearm upon the humerus. Thirdly, an unnatural projection of the olecranon which has above it a hollow, and on the anterior part of the arm a tumor-like prominence is seen, which is caused by the lower end of the upper fragment being drawn forwards and downwards by the muscles on the anterior aspect of the joint. Fourthly, the return of the deformity when extension for dislocation is discontinued. Fifthly, a preternatural mobility, which may be noticed before swelling supervenes. Sixthly, that the relation of the condyles with the olecranon remains unchanged. From several measurements and casts of sound arms I am led to believe that in the normal state a line drawn from the most prominent points of the internal and external condyles and lines drawn from the extremities of this line to the olecranon form a right-angled triangle, the first line drawn being the hypothenuse. This relation is obtained only on flexing the arm. When the arm is extended the angle is obtuse.

In case of dislocation of the radius and ulna backwards would be noticed, — First, limited flexion and extension. Secondly, that on extension all marks

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of dislocation are removed. Thirdly, absence of crepitus. Fourthly, a marked change in the relation of the condyles and olecranon. Fifthly, a marked prominence of the olecranon, which has a resemblance to the shape of the heel of the foot, the triceps being brought into a state comparable to the tendo achillis, and the olecranon to the os calcis. Ordinarily there would be pain from pressure on the ulnar nerve. Sixthly, a shortening of the forearm.

Fracture of the coronoid process might produce symptoms similar to these; but in the diagnosis should be considered, first, the rarity of this fracture; secondly, that in the fracture above the condyles, the olecranon and the condyles preserve their normal relation, whereas in fracture of this process the olecranon would project unnaturally; thirdly, that in case of fracture of the coronoid process, when extension is suspended, the deformity returns, which does not occur in ordinary dislocation of the forearm backwards.

The cause of the accident may assist in the diagnosis. A fracture at the base of the condyles is almost invariably due to a fall on the elbow, while a dislocation of the radius and ulna backwards cannot be; a dislocation is caused by a fall on the palm of the hand usually; a fracture thus is rare.

Hamilton records sixteen cases, ten of which happened in children under ten years of age.

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In five fractures from the fracture books before alluded to, there were four females and one male at an average age of nine years.

Separation of the lower epiphysis without involving the joint occasionally happens in children before ossification is complete. The diagnostic peculiarities are nearly the same as in fracture at the base of the condyles. Preternatural mobility allowing lateral motion may be obtained, as may also crepitus. On this point Erichsen says that it happens without crepitus, as it is between cartilaginous surfaces.

The lower end of the upper fragment is broader than in fracture at the base of the condyles, and the line of separation is nearer the extremity of the bone. The cause is the same as that which produces fracture at the base of the condyles. It may be mistaken for dislocation of the radius and ulna backwards, but the symptoms which the latter present will serve to distinguish them.

Hamilton has never met with a case of separation of this epiphysis.

In the fracture books there are four cases recorded at an average age of six years. At the end of this paper will be seen a drawing of the separation of the epiphysis of the internal condyle.

II. A T-shaped fracture into the joint is of a more serious character than the preceding, as it in-

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volves the joint, and consequently there is more or less inflammation, which is followed, usually, by permanent deformity and bony anchylosis. Hamilton has recognized this fracture six times. In the fracture books before mentioned, there are five cases of this fracture, three of which had a perfect result. They occurred at an average age of three and a half years.

Although this fracture is but a complication of the preceding, its symptoms differ somewhat. In addition to the symptoms of fracture at the base of the condyles, is to be noticed an increase in width at the bend of the arm, owing to the separation of the condyles, and an appearance of antero-posterior flattening.

The separation of the condyles from each other may be ascertained by grasping and moving them backwards and forwards, when, unless the swelling about the joint and the effusion into it are very great, crepitus will be obtained. This accident is also liable to be mistaken for dislocation of the radius and ulna backwards, especially when the arm is flexed.

III., IV. The fractures of the internal condyle into or outside the joint may be considered together. The former is the more serious accident.

South, Sir Astley Cooper, and the writers in Holmes's "Surgery" speak of fracture of the in-

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ternal condyle as very common, and more so than fracture of the external condyle; while Malgaine considers it exceedingly rare.

Hamilton has seen more fractures of the external than of the internal condyle. In seventy-one fractures in the lower third of the humerus, fifteen were through the internal condyle and epicondyle, eighteen through the external condyle, sixteen at the base of the condyles, six T fractures, the remaining sixteen were above the base.

On *à priori* grounds we should expect, however, that the internal condyle, as it is the more prominent, would be the oftener fractured; and such I find is the case from statistics collected from the fracture books for the last four and one third years.

Injury.	Number.	Males.	Females.	Average Age.	Exceptions.
External Condyle . . .	20	16	4	6+	2 of 50 yrs. each, 1 of 30 yrs.
Internal " . . .	32	22	10	8	
" " into joint	7	6	1	9	1 of 17, 1 of 35, 1 of 21 yrs
Just above Condyles . .	5	1	4	9	
Separ. epiph. humerus . .	4	1	3	6	
T fracture	5	1	4	3+	
Olecranon	8	5	3	48	1 of 5 yrs., 1 of 11 yrs.
Ulna upper third	3	3		52	1 of 11 yrs.
Head of radius	2	1	1		1 of 18 mos., 1 of 52 yrs.
Separ. upper epiph. of radius	1		1	5	

In the reports of the Boston City Hospital for seven years from 1864, record is made of twenty-four fractured internal condyles, and fourteen fractured external condyles.

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This fracture, whether involving the joint or not, is confined almost exclusively to childhood; Sir Astley Cooper says he has seen it less frequently in old people, and we see such is the case from the foregoing table.

In the fifteen cases that Dr. Hamilton has seen, only two patients were as old as eighteen years.

The cause of this fracture is, as Dr. Hamilton states, a direct blow on the elbow, on the inner side of the arm.

I have record of the case of a boy of twelve years, in whom this lesion was caused by a fall on the hand. This is rare.

If the accident is the result (as is asserted) of muscular contraction, the fragment will probably be drawn in the direction of the muscular fibres, i. e. downwards and a little inwards.

If the internal condyle is broken completely off, there is reason to suppose that the flexors and pronators which arise from it will draw the fragment below the joint. These muscles can now no longer assist the supinator longus, brachialis anticus, and biceps in the flexion of the arm. Their action in flexion, however, is, according to the best authorities, very limited. Dr. Barclay, in his work on the muscular motions of the human body, p. 396, says that "the pronators and flexors are flexors of the forearm only

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to a small extent, and then only at a time when motion commences, and before the lever of resistance is shortened, and the levers of the biceps and supinator are lengthened. The various motions of bending, grasping, and turning the hand can be performed with much the same degree of force when the inner condyle is retracted below the elbow-joint as when it was situated on the humerus."

Soon after the accident, the movements of the joint are more or less restricted, on account of the swelling and of the detachment of the fragment, which has not become fixed in its new position. The arm usually cannot be fully flexed. The principal diagnostic symptoms are, the mobility of the fragment and the crepitus, which may be usually obtained by grasping the condyle, unless the swelling is very great, on flexing and extending the forearm. The ulna appears dislocated; because it projects behind the humerus with the broken condyle when the arm is extended; on bending the arm, however, the ulna resumes its natural situation. When the arm is extended, the flexors and pronators are made tense, so that the internal condyle is carried upon the ulna, and may be felt on the anterior part of the joint as a tumor.

The fragment can seldom be kept in place; yet, although some deformity may remain, the movements

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of the elbow are generally but little interfered with, unless the injury to the articular surfaces is extensive. The ulnar nerve sometimes is injured by pressure of fragments of bone; this injury is evident by the little finger and ulnar half of the ring finger front and back being benumbed.

Dr. Markoe * has shown that this fracture has taken place in the three dislocations of the head of the radius backwards that he has seen.

Dr. Hamilton says that the line of fracture is tolerably uniform; it commences about $\frac{1}{4}$ or $\frac{1}{2}$ inch above the internal epicondyle, and extends obliquely outwards through the olecranon and coronoid fossæ, and enters the joint through the centre of the trochlea.

V. Fracture of the internal epicondyle (Epitrochlea Chaussier) was first reported by Granger.† This does not implicate the joint. Granger attributes it solely to muscular action, but Dr. Hamilton thinks that Granger in his article has failed to maintain his point. He thinks that most of the cases were produced by direct blows. Fractures of the internal condyle are caused, we have seen, chiefly by direct blows, and there is reason to believe that most fractures of the epicondyle are caused in like manner. On the other hand, it occurs more frequently in

* New York Journal of Medicine, 1855, p. 382.

† Edin. Med. and Surg. Journ., Vol. XIV. p. 196.

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children before the epiphysis has united, when muscular contraction would be more likely to produce the result, as at this time the epicondyle is less prominent and, therefore, less exposed to blows than in adult life. Of five fractures of the internal epicondyle which Dr. Hamilton has recognized, all except one occurred between the ages of two and five years.

Malgaine has seen a case in a man fifty-two years of age; he says it is the result, as a rule, of a fall on the elbow, and that by a fall on the hand is very rare. Granger records the case of a boy eight years old, who fell on his hand and broke off completely the inner epicondyle. The fragment was displaced toward the hand. He recovered free and entire use of the hand in less than three months. No splints or bandages were employed.

The cause of this accident is open to doubt.

Granger found in five cases the epicondyle varying in position; in some cases it touched the olecranon, in others it moved an inch, or more, in the opposite direction. He thinks that it usually moves downwards, in the direction of the principal muscles which arise from this epiphysis, especially when the accident is the result of muscular action, as he claimed his cases were. The fragment may be movable, and crepitus may be obtained; in addition to this, there is usually some difficulty in the motions of the elbow-

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joint, which is due, I think, more to the swelling than to the detached bone.

VI. The best surgeons think that fracture of the external condyle can take place only into the joint, and that, therefore, it is almost always followed by some permanent impairment in the movements of the joint. The comparative frequency of fractures of the condyles, from my statistics, is, internal condyles sixty-three, external condyles thirty-four.

Dr. Hamilton says, "All the fractures of this condyle of which I have a record (eighteen) occurred in children under fourteen years of age, except one, which was the case of an old woman, eighty-eight years old, who fell on her elbow, and in two months found the fragment displaced one half-inch upwards, and there firmly united."

In the foregoing table it will be noticed that of twenty fractures, at an average age of 6 + years, sixteen are males. There were three exceptions to the average age; two of fifty years each, one of thirty years, all males.

This fracture is characterized by some degree of œdema, and by pain on pressure and on moving the joint. The chief diagnostic signs are crepitus on rotating the radius and on rubbing the fragment against the humerus, when the arm is extended; the existence of a tumor-like projection on the outer and

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posterior part of the elbow; the supine position of the hand; and the constant semi-flexion of the forearm.

The line of fracture generally commences above and without the capsule, and enters the joint either through the capitellum or the middle of the trochlea; more commonly the former. The degree of displacement depends upon the size of the fragment, and the continuity of its ligamentous connections.

If the piece of the fractured condyle is large, it is drawn a little backwards by the pressure of the radius caused by the action of the biceps. If the fracture passes to the inner border of the trochlea, there will be probably displacement backwards of the ulna, together with the radius.

Fractures of the Upper Extremity of the Bones of the Forearm.

The explanation of the comparative infrequency of fracture of this part of the radius and ulna is the fact, that the extremities of the bones, except the olecranon, are protected by the enveloping bellies of the muscles of the forearm, so that a simple fracture at this point is of rare occurrence. The existence of fracture of these bones may be ascertained by tracing with the finger the course of the bones on their most superficial aspect.

Whether the radius is involved may be ascertained

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by grasping the forearm, and rotating it with a finger of the other hand on the head of the bone, just below the external condyle. If the head rests motionless while we rotate, we have strong presumptive evidence that the bone is fractured somewhere below. The diagnosis of a part of the head of the radius when chipped off is exceedingly difficult, if not impossible. The existence of such a fracture has not, as far as I am aware, been diagnosticated during life. It has been overlooked by skilful surgeons, and has been revealed only by subsequent dissection.

The diagnosis of fracture of the olecranon is the most simple of the bones in this part of the forearm. The diagnosis of fracture of the coronoid process can doubtfully be determined by elimination.

The ulna may be fractured at the olecranon, the coronoid process, and rarely at the upper part of the shaft. The most frequent fracture of the bones of the forearm in the vicinity of the elbow is that of the olecranon, which we will now consider.

Olecranon.

This process may be fractured at its summit, its base, or midway between the two. The latter is the most frequent form of accident. The line of fracture generally is transverse or slightly oblique in the line of junction of the epiphysis and diaphysis.

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Dr. Hamilton has recorded twelve cases caused by falls or blows. Malgaine collected thirty-five cases. Of these, twenty-seven were caused by falls, three by blows, and five by muscular contraction. Dr. Hamilton thinks that it is impossible to affirm that the whole process was broken off by the muscular contraction of the triceps extensor. By such a cause the summit only would be likely to be broken off.

In comparative frequency, in fractures of the upper extremity that of the olecranon is almost unknown. During sixteen years there were treated at the Middlesex Hospital two thousand seven hundred and five fractures of the upper extremity, of which seventy-six were of the olecranon. Malgaine, during service at the Hôtel Dieu, saw, in eleven years, nine cases of fracture of the olecranon.

From the foregoing table it will be seen that there have been treated during four and one third years eight cases, five males and three females, of an average age of forty-eight years. A boy of five years met with this fracture, as did also one of eleven years. They both had perfect results. From the City Hospital books I find a record of one fracture of the olecranon in 318 fractures of the humerus, radius, and ulna.

Dr. Cheever reports * a fracture of the olecranon in

* Boston Med. and Surg. Journ., Jan. 16, 1868.

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a boy of twelve years, which in four weeks had excellent union.

This fracture is more common in men than in women, and occurs usually in middle life. It is stated in Holmes's "Surgery" that before the age of fifteen it is almost unknown. Many of the books say that when the olecranon is fractured, it is drawn upwards by the triceps; this I think by no means always occurs. The lateral ligaments, and especially that part of the internal lateral ligament which stretches across from the coronoid process to the olecranon, will retain the fragment in its place, unless the cause is very violent. In some cases, however, the fragment is drawn up by the triceps from one half-inch to an inch and a half, and the extent of its separation depends on the degree of laceration of the capsular and internal lateral ligaments.

If the fragment is detached, it may be known by tracing the subcutaneous border of the ulna backwards, when a distinct depression will be felt at the elbow, above which the detached olecranon, movable laterally, can be felt. The interval between the fragment and the ulna is increased when the elbow is bent.

If the fragment is not separated, gentle flexion and extension of the arm, while the finger rests upon the process, may aid in the detection of the fracture.

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The power to extend the arm is very much impaired, and the attempt produces much pain. A bulging of the triceps, just above the elbow-joint, is a strong diagnostic point. When the fragment is not separated, crepitus can often be obtained by moving the fragment laterally. If the fragment is separated, and there is but little swelling, the diagnosis is easy. Crepitus in this case can only be obtained by extending the forearm, so that the fractured surfaces can be brought into contact.

If the relative position of the condyles and the olecranon is noticed, it will be seen that a *right angle* is no longer formed by these processes, but that it is now an acute angle, if the olecranon has been drawn upwards.

The olecranon usually unites by ligament, and for a different reason for failure of union within joints.

This point Sir Astley Cooper established by certain experiments on animals, and has shown that this process, like the os calcis and patella when they are fractured, is detached by the action of muscles, and ligamentous union ensues for want of adaptation. That osseous union does occasionally occur we have proof in a case reported by Mr. Fletcher,* who relates the case of a boy sixteen years of age, who fractured both olecranons, and whose death ten months

* Med. Times and Gaz., 1851, Vol. II. p. 173.

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afterwards afforded an opportunity of examining the state of the injured parts. The union was osseous, and the displacement had not been very great.

Care must be taken in accepting statements of osseous union here, as there are certain appearances which are similar to fracture with bony union. My attention was called to this fact while dissecting an elbow a short time since, with reference to the posterior ligament. On opening the joint, I noticed what I thought was a fracture of the olecranon, with bony union. Several friends concurred with me in that opinion. The next day, while examining the other elbow on the same subject, my suspicion in regard to the character of the first was aroused on finding that this, too, presented a similar appearance. On closer inspection it was found that the cartilage was simply gone at the depression of the articular surface which marks the separation of the coronoid process and the olecranon.

It has been noticed that fracture of the olecranon, owing to the superficial location of the process, is often of a complicated nature, and that it is more frequently compound than other fractures of this joint. When the lesion is of such a character, violent inflammation of the elbow-joint may arise, ending in permanent anchylosis, caries, or necrosis.

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Coronoid Process of the Ulna.

No specimen of this fracture as a simple one, as far as I know, exists. Dr. Hamilton says that the possibility of its occurrence has been established by dissection.

Quite a number of supposed cases of this fracture have been reported. The difficulties in the way of diagnosis are great. But few cases have been verified by dissection.

Malgaine states that Combes Brassard published the first case of fractured coronoid in 1811. The subject fell on his hand when his arm was extended. He had all the motions of the joint, except complete flexion, which he could not make, as there was a hard body between the ulna and the humerus, which stopped it. The lesion was three months old when Brassard saw it.

Pennock reported a case of this accident in a man of sixty years, it having occurred when he was a young man. Neither of these cases was satisfactory to Malgaine.

Sir Astley Cooper speaks of the case of a man who had met with an accident, and says, "It was thought at the consultation that the coronoid process was detached from the ulna." He speaks very cautiously of this case.

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Dorsey says that Dr. Physick has seen the coronoid process of the ulna fractured once, and says that it resembled a dislocation of the forearm backwards, except that when extension was suspended, the same dislocated appearance reappeared; he says that crepitation was discovered, and that a perfect cure was readily obtained. This is a hearsay case, and is doubted by Dr. Hamilton.

Dr. Fahnestock reports a case which presents the same features as Dr. Physick's case, and recovery was speedy. This case belongs in the same category as the preceding.

Dr. Couper reports a case, and bases the diagnosis of fractured coronoid upon the fact that dislocation of the forearm backwards occurred as soon as extension was suspended. This is not sufficient evidence. This case, moreover, is doubted by Dr. Johnson.

Dr. Duer reports a case which was complicated with dislocation. The diagnosis was not certain, and could have been better verified at a later period.

The diagnosis of a case* on trial was not made out satisfactorily either to the jury or to the medical men.

Mr. Liston says, "I saw a case of this fracture, in which the injury arose in consequence of the patient, a boy of eight years, having hung for a long time from the top of a high wall, afraid to drop." He

* Amer. Med. Monthly, Oct. 1855.

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says it is occasionally pulled or pushed off from the shaft, more especially in young subjects. This case is cited and believed by several Scotch and English surgeons. Dr. Hamilton, on the other hand, thinks that this process cannot be broken off by the action of the brachialis anticus, as the explanation of the fracture in this way implies two anatomical errors: first, that the process is an epiphysis; secondly, that the brachialis anticus is inserted upon its summit. In the development of the ulna we saw that the coronoid process is an apophysis and not an epiphysis. The brachialis anticus is not inserted into the summit of the process, but partly at its base and partly on the body of the ulna.

Dr. Lotzbeck has written an essay on "Fractures of the Coronoid Process." Zeis has written a review of this.* A number of cases are here reported. The diagnosis is based upon the symptoms, and in no case upon dissection. The evidence in some of the cases is probable, but not conclusive. In a rare form of fracture, as of the coronoid process, dissection alone proves its existence.

Dr. Cheever,† in his synopsis of the surgical cases for three years at the City Hospital, says that "one fracture in the upper extremity was noticed, and was

* Schmidt's Jahrbuch für 1866, Vol. CXXIX. p. 134.

† Boston Med. and Surg. Journ., Jan. 2, 1868.

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the very *rare* one of the coronoid process of the ulna. A boy nine years old came with both bones of the forearm dislocated backwards. The joint fell out of place as often as it was put in. No fracture at the lower end of the humerus, the condyles, or the olecranon; and as a proof that something more than an ordinary dislocation backward had occurred, the arm was placed on an angular splint, became anchylosed (false anchylosis). It did not regain its power of motion when it was moved (and it was moved early), and required the usual treatment of several weeks' passive motion, to restore its functions." He says, "We mention this case with diffidence, well knowing that the existence of the fracture is disputed, and having suspected it in another case, where early mobility of the joint proved that we were mistaken." This case is certainly as well made out as a case could be without dissection.

Gross * mentions a case reported by Dr. Scott, in which he says, "The fractured coronoid caused a distinct prominence on the anterior and inferior surface of the humerus, a short distance above the joint, movable from side to side, the olecranon being at the same time displaced backwards, and the forearm flexed. The cause was a fall on the hand when the arm was extended."

* Surgery, Vol. I. p. 975.

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This case was not verified by dissection. I think that it is almost impossible for the coronoid to form a distinct prominence above the joint; also that a lesion of the internal condyle might explain the above case better than that of the coronoid process. I say this, as I have seen a case very much like the preceding.

Dr. Hamilton knows of only four specimens mentioned by any surgical writers.

1. Sir Astley Cooper mentions a case which was from a dissecting-room, and had no history. The coronoid and external condyle were broken, and both had united by ligament.

2. S. Cooper vaguely describes a complicated accident of the elbow, in which he says the coronoid process was broken off.

3. Malgaine says that Velpeau established the existence of the fracture of this apophysis by an autopsy.

4. Dr. Gibson of Virginia describes a case in which the fracture united by bone.

Dr. Hamilton thinks that in the case said to have been seen by Velpeau the proof is wanting.

He doubts Dr. Gibson's case, as he thinks one can be easily deceived by certain appearances. In this specimen there is no line of separation, nor was there any displacement.

He says, "Rejecting the doubtful specimens,

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we have an exact account of only two; and, indeed, Sir Astley Cooper alone has described the mode of union."

To the above specimens I add three: —

1. Bryant, in his "Surgery," p. 852, figures a fracture of the coronoid process and head of radius in a woman of seventy years. She fell on her elbow. The injury demanded amputation. The specimen is in Guy's Hospital Museum, and is referred to by Holmes.

2. Holmes records the case of a man killed by a fall from the roof of St. George's Hospital, in whom the coronoid processes were fractured, and the two bones of the forearm dislocated backwards on both sides.

3. A case of mine, reported at the end of this paper, with the history and drawings of the specimen.

Malgaine, in certain experiments on the cadaver, has found that the summit of this process is often broken off where dislocation of the radius and ulna is artificially produced, and thinks that only a small proportion of the cases that occur are reported.

The complication of dislocation of the forearm backwards took place, as far as we know, in only one of the five cases of which there are specimens.

Erichsen says that considering fracture of the coronoid a common complication of dislocation of the ulna backwards is a mistake, as it is one of the rarest accidents in surgery.

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Ferguson's extraordinary statement, that in dislocation of the radius and ulna backwards "the coronoid process will probably be broken," is in strong contrast to the above.

Gross, in his "Surgery," p. 974, says, "I have never met with the accident in the living subject, and I am not aware that a solitary specimen of it exists in any of the osteological collections, public or private, in the United States."

Dr. Hamilton says, p. 306, "The fact that so few cases have ever been reported, and that most of these are far from having been clearly made out, remains presumptive evidence that the actual cases are exceedingly rare; but if to this we add such negative evidence as is furnished by actual dissections, and by examinations of the pathological cabinets of the world, we think the testimony is almost conclusive."

The cause of this accident in the comminuted specimen in Guy's Hospital was a fall on the elbow; in my case, a fall on the hand. A fall on the hand will probably produce this accident more frequently than any other way; the force of the blow is received directly on the radius, and, through its numerous muscles and ligamentous attachments, is indirectly conveyed to the ulna, producing a violent concussion of the coronoid process against the trochlea of the

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humerus, and resulting in fracture of this process. The greater frequency of Colles's fracture from the same cause is explained by the intimate connection of the carpal bones with the lower extremity of the radius. Hamilton says there is much doubt as regards the symptoms of this fracture, and that it cannot be removed until the symptoms of at least one example are given, the indubitable existence of which has been subsequently verified by dissection. In none of the dissected specimens that are reported are the symptoms given. In my specimen there was a partial displacement of the ulna, which disappeared on flexion. There was no crepitus, nor was the process displaced or movable. This specimen was fractured at the base.

The symptoms in case of fractured coronoid are necessarily very obscure, and the diagnosis extremely difficult.

Fracture of the Upper Extremity of the Radius.

This may be (1) of its head, (2) of its neck. When the radius is broken near its upper extremity, the depth of muscles in which it is imbedded masks the fracture, and renders the diagnosis exceedingly difficult, if not impossible. A very small percentage of fractures of the radius take place in its upper third.

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In one hundred and one fractures of the radius recorded by Hamilton, not including gun-shot wounds, three were in the upper third, six in the middle third, and ninety-two in the lower third. In two hundred and fourteen fractures of the radius, in the fracture-books before referred to, eight were in the upper third, thirty-one in the middle third, and one hundred and seventy-five in the lower third, of which one hundred and fourteen were Colles's fracture. Fracture involving the head or neck of the radius is conceded to be very rare.

Fracture of the Head of the Radius.

Very few works on surgery mention this form of fracture, and these concede its rarity. Gross gives a figure of a rare form of fracture of the head of the radius, which he has in his collection, in which a portion of the head has been chipped off and permanently united to the contiguous border of the coronoid process of the ulna. As the specimen came from the dissecting-room, the history is unknown.

Dr. Hamilton * says that he has seen in Dr. Mütter's cabinet two specimens of fracture of the outer half of the head of the radius. In one case the small fragment is slightly displaced downwards, in the direc-

* Fractures, p. 270.

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tion of the axis of the bone; in the other the fragment is thrown outwards, or on the radial side. Both are firmly united in their new positions.

Dr. Hodges* records a case in which the essential features of the injury were correctly diagnosed by the surgeons who saw the case, but the *post mortem* dissection revealed a longitudinal fracture without displacement of the head of the radius, which was not detected during life by any one present. The split involved nearly one half of the head of the radius, cleaving outwards so as to extend no farther than the neck of the bone, accompanied by an oblique fracture of the shaft of the ulna. Had the split which passed down the shaft of the ulna terminated anteriorly (toward which aspect it inclined and came nearest) instead of posteriorly, there would have been a fracture of the coronoid process of the ulna. This specimen, No. 1031, is in the Warren Anatomical Museum. Excision was performed, and the man died six hours after the operation. Dr. Hodges has met with this rare accident three times; the specimens are in the Warren Museum.

No. 1031. Before described.

No. 1024. Frac. ext. condyle and one third head of radius. Excision for injury, well in seven and one half weeks.

* Boston Med. and Surg. Journ., Dec. 6, 1866.

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No. 1026. Frac. one third head of radius; comminuted frac. of the upper part of the ulna, including part of the coronoid process.

Malgaine * says this has happened only twice, and in these cases it was combined with fracture of the coronoid apophysis, and dislocation of the forearm backwards. In one, dissection showed fracture of the coronoid, and another fracture, which, passing across the head of the radius, descended obliquely more than a half-inch on the anterior face of the bone. The other case was of a man of fifty years, who had a violent fall, in which his elbow was dislocated; this was mistaken for a contusion; Velpeau was consulted, who tried in vain to reduce the dislocation. The man died soon after, and dissection demonstrated luxation, fracture of the coronoid, and a transverse fracture on the anterior surface of the head of the radius. In the two specimens of fracture of the coronoid process before referred to as being in the Museum of St. George's Hospital, the head of the radius was also split longitudinally.

Bryant, † in his "Surgery," gives a drawing of comminuted fracture of the head of the radius, and fracture of the coronoid process in a woman of seventy years.

* Fractures et Luxations, Tome II. p. 636.

† Amer. Edit., p. 854.

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It is very doubtful whether this accident can be recognized during life.

The cause of the accident probably would be a fall on the hand. Bryant's case, however, was caused by a fall on the elbow.

The only instances I find of this fracture being uncomplicated are the cases in the table. The one took place in a man fifty-two years old, the other in an infant of eighteen months. The history which the mother gave of the latter case was, that "she was gently lifting the child up stairs by one hand, when she felt something give way." This case probably belongs in the same category as Liston's case.

Fractures of the Neck of the Radius.

Sir Astley Cooper never saw a case of this, and says it must be very rare. Uncomplicated with any other fracture or dislocation, Dr. Hamilton says it is exceedingly rare. South says it is not an "unfrequent accident," but cites no cases. The possibility of the occurrence of this accident is denied by some. Owing to the proximity of the radius and ulna, diagnosis during life is very difficult, if not impossible.

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Dr. Hamilton has seen no specimen obtained from the cadaver, except the doubtful one contained in Dr. Watts's cabinet,* and the specimen owned by the late Dr. Mütter, of Philadelphia, of which there is a drawing and description in Hamilton's "Fractures," p. 268.

Malgaine says that he has never seen this fracture.

Velpeau once demonstrated this fracture, but there was also a fracture of the coronoid process. Bérard had a similar specimen.

Dr. Hamilton cites † three supposed cases of this fracture. In two there was anchylosis, and in the third very little motion at the elbow, with complete loss of supination and pronation. Dr. Hamilton thinks that he has met with one case of uncomplicated fracture of the neck of the radius; still he is in doubt in regard to it.

There is an example of this fracture in the fracture-books in a man of fifty years. It was complicated with fracture of the external condyle.

There is also an instance of separation of the upper epiphysis of the radius in a child of five years.

In the latter part of this paper will be seen a drawing of a section of the head and neck of a radius, showing an impaction of the neck of the

* For account *vide* Amer. Med. Assoc. Trans., Vol. IX. pp. 157–229.

† Fractures, p. 270.

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radius, a form of accident which has not been described by surgeons so far as I am aware.

To diagnosticate this fracture, it is best to put the thumb on the external condyle and the head of the radius, and, at the same time, the hand is to be brought to the prone and supine positions. In these trials, which are always painful, if the head of the bone rests motionless there can be no doubt but that the shaft is fractured somewhere. The integrity of the shaft as far as the neck may be determined by external pressure.

Compound Fractures of the Elbow-Joint.

Compound fractures of this joint are quite frequent, and are necessarily serious accidents, and come usually either to excision or amputation. Excision for traumatic cause is a safer operation than amputation, and ordinarily preserves a limb of very considerable usefulness. If the articulation is simply opened with little laceration of tissues and no comminution of the bones, active antiphlogistic treatment should be pursued. If the bones are much shattered, and the tissues are implicated, removal of the splinters and excision of the joint will enable the surgeon usually to save the limb. If there is extensive contusion of the soft parts and they are much

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torn, as well as the bones splintered, amputation of the arm will generally be required. If the skin and tissues are torn but little, is is best to apply a piece of lint dipped in blood, or some such treatment, to keep them from contact with the air. The best surgeons * say that poultices should not be applied in the treatment of these accidents, as the adhesive process is prevented by their use, and suppuration and ulceration are produced, which endanger life, or render amputation necessary. If the fracture is compound, and extends into the joint, there will be necessarily more or less inflammation of the joint, which is almost always followed by permanent impairment in the movements of the joint. The patient should be cautioned against using his arm too freely at first.

Treatment of Fractures at the Elbow.

Most surgeons agree in what position the fractured elbow should be put, but as regards subsequent treatment, nearly every surgeon has rules of his own.

It is always best to etherize the patient, so that, without pain, the character of the injury, if possible, can be ascertained.

The next step is to ascertain whether the olecranon is fractured, and then whether there is a dislocation.

* Hodges on Excision of the Joints, p. 52.

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Whether a diagnosis is made or not, the correct treatment is an internal rectangular splint for all injuries at the elbow, except that of the olecranon, which requires the arm to be extended, and therefore a straight splint.

Dr. H. J. Bigelow's advice is "to treat all other fractures except that of the olecranon as though the forearm had been dislocated backwards, to draw the wrist forward, while the humerus is pushed backward, and forcibly to maintain it in position while the fragments are adjusted, after which to apply a padded internal angular splint." A well-fitted tin rectangular splint is as good as any.

Much swelling often supervenes, which obscures all the bony prominences, except usually the olecranon. The books say that, in such a case as this, it is best to keep the arm quiet for a few days on a pillow, if the patient can be kept in bed, and to treat it antiphlogistically. It seems to me that it is better always to apply an internal angular splint with a loose bandage, leaving a space at the joint to apply any evaporating lotions that are desired. It is well to incline the arm on a pillow.

The treatment of fractures of the olecranon has differed at various times, and in different countries The early surgeons treated this fracture in the semiflexed position, claiming that there was less danger

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of anchylosis; and if unfortunately it did occur, the arm would be in the most serviceable position. For arguments pro and con, *vide* Hamilton on Frac. p. 314, and Malgaine's Frac., Tome I. p. 572.

Most French surgeons treat it in a position in which the forearm is slightly bent upon the arm.

Sir Astley Cooper and the majority of English and American surgeons say that the best treatment is by extreme extension, in order to approximate the broken fragments as nearly as possible.

Ferguson * gives a cut of a fractured olecranon united by ligament, resulting in partial loss of power of the triceps; to prevent which the arm should be well extended. Surgeons are so accustomed to bend the elbow-joint in injuries of the arm, that they bend it in general in fractures of the olecranon. The surgeon should be cautious not to bend the elbow before the injury is determined, as it may occasion a laceration of the lateral ligaments.

The indication in treatment in all these fractures is to relax the muscles attached to the fractured part: thus, if the internal condyle is fractured, the hand should be pronated; if the external, supinated.

Nevertheless, Granger seems to be correct in his views as applied to fractures of the internal epicondyle, namely, that it was of little or no conse-

* Surgery, p. 210. 3d Amer. Ed.

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quence whether the fragment united or not, and that the elbow-joint ought to be submitted to free motion from the beginning to the end of the treatment.

In fracture of the neck of the radius, the supine position of the hand is advisable.

Not long ago there were in Boston two schools, as it were, in the treatment of fractures at the elbow: the one holding that no splints should be used, but the arm kept in a sling for three days, and then that passive motion should be employed; the other, that splints should be used for three weeks at least, deprecating passive motion, except the gentlest possible. I have seen the latter views carried out in quite a number of cases, and have had no reason to believe them to be incorrect.

Before the patient recovers from the ether, the fractured parts should be moulded into place as nearly as possible, and the padded splints applied with bands of plaster, and bandaged. The arm should be put in a sling, the inside end of which should go over the shoulder of the injured arm.

There is danger in applying a bandage immediately to the limb if the parts are œdematous; it should only be applied when the splint causes the œdema (which, however, if properly applied, it rarely does).

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The patient should be seen the next day after the bandage is put on, to see that it is not too tight, and from time to time for three weeks if a child, for four, if an adult. If false anchylosis has taken place, gentle passive motion should be employed. When this should be commenced, authorities differ. Sir Astley Cooper says in three weeks after the accident, Malgaine in twenty days, and Hamilton within seven days, and perhaps earlier, and that it is better not to resume the splints after the period of using passive motion has commenced. Passive motion must constitute the principal occupation of the patient for several weeks.

Anchylosis may occur, even when there has been no inflammation of the joint, from disuse, or from having neglected at the proper time, and with sufficient perseverance, to move the joint. The elbow may be almost immovable when the splints are removed; a somewhat favorable prognosis is to be given, however, if the arm can be flexed and extended through an arc of even half an inch, and it lacks springiness. Time and the co-operation of the patient will usually overcome this. In obstinate cases in which gentle daily motion does not suffice, it is well to apply a light weight to the wrist, and to allow the arm to hang down, in this way obtaining a moderate, steady extension. It is almost

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unnecessary to say that, while the splints and bandages are on, constant vigilance is required to see that they are properly adjusted.

Mode of Union.

Ligamentous union usually occurs in fractures within a capsular ligament. The old view of the impossibility of intra-capsular osseous union is not held, as osseous union occurs in impacted fractures.

Union within joints is ordinarily ligamentous for the following reasons: —

1. The absence of that irritation which determines the formation of callus.

2. For want of proper nourishment of the terminal fragment, as the nutrient vessels are more or less lacerated, the little nutrition that exists being derived from the blood-vessels intended for the nourishment of the ligament.

3. The difficulty of maintaining the fragments in apposition. Various conditions are necessary to determine the time requisite for union. In general it varies from twenty to forty-five days.

Prognosis.

The prognosis of fracture at the elbow-joint depends on whether the joint is involved. If it is, the

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injury is more grave, and consequently the prognosis is more uncertain. Many cases of severe injuries into the joint result well if properly treated; still, to prevent error, if the joint is involved the surgeon's answer should be guarded, remembering the numerous lawsuits that have arisen from the surgeon's presumption. Time is required in many cases before unimpaired motions of the arm result.

A Case of Fracture of the Coronoid Process, Partial Fracture of the Olecranon, Impacted Fracture of the Neck of the Radius, and Separation of the Epiphysis of the Internal Condyle, followed by Excellent Motion.

In November, 1872, a subject was brought into the dissecting-room of the Harvard Medical School, whose right arm attracted my attention. By exchanging, I obtained possession of the arm. Externally the arm differed from the left. It was somewhat broader posteriorly, the olecranon was very prominent, laterally the forearm formed an obtuse angle with the upper arm, the internal condyle was more prominent than the external, and a small fragment of bone was movable near the external condyle.

No crepitus was detected, the skin was not broken, nor was any scar visible. Mobility was natural, except pronation and supination, which were somewhat

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limited. By careful measurement, and comparison with the left arm, a shortening of the radius was noticed of one half an inch. On dissecting the joint, I found that an unusual occurrence had taken place, and thought that the details of the case, if obtained, might be interesting. From a visit to Tewksbury, whence the body came, and from correspondence with the patient's physician, I learned that Miss J. B., *æt.* 22, had been in various State institutions, and was at the State Almshouse five years. She is said to have been quite intelligent. She was subject to epileptic attacks, which did not occur very often, but were very severe. At the commencement of an attack, she is known to have fallen in the yard, off the steps, and out of bed. Eight months before death she had a severe fit in which she fell out of bed. No fracture was detected. I agree with Dr. Marsh in thinking that the injury took place at some previous time. The Doctor says that motion of the arm could not have been restricted much, as she was a "helper" in a ward. Her duty was to take care of feeble-minded people (when she could take care of herself), to comb their hair, and lead the blind. No deformity nor impairment in the motions of the arm was noticed after her last fall, although she was seen often at work. She died by asthenia with typhoidal symptoms.

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A careful examination of the specimen shows that the injury occurred previously to her last fall, and was caused undoubtedly by a fall on the hand while the arm was extended, as in this way only could the impacted fracture of the neck of the radius, with the accompanying fracture of the coronoid process, take place.

We see in museums misshapen joints, the result of chronic rheumatic arthritis. In this case we get no history of this affection, the joint is healthy, the surface is smooth, the cartilage is normal, as are also the ligaments, except the posterior, which is somewhat thickened. The muscles were healthy, and, with the exception mentioned, the joint was as healthy as that of the left arm.

Description of Specimen.

Fig. I. is a posterior view of the joint. The radial side of the humerus is tilted forwards to meet the shortened radius. *a* is the separated epiphysis of the internal condyle, which passes from the coronoid to the olecranon fossæ, and does not involve the joint. The union is ligamentous. The line of separation is seen at Fig. II. *a*. The internal condyle does not project as far posteriorly as normally. It has slipped forwards, and thus the falciform process, Fig. II. *c*, is produced.

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c is an exostosis measuring 1 cm. by ½ cm.

d is a movable fragment of bone, in contact on its under surface with the external condyle, to which it is attached by ligament on its superior border. It is of the same size as *c*.

e is a small fragment of bone attached by ligament to the inner posterior border of the capitellum of the humerus. The size and shape of *e* suggest that its normal place may have been Fig. III. *a*. It is wholly within the joint, and in flexion slips to the radial side of the olecranon.

Figs. I., II. *b* is the posterior ligament inserted into the posterior tip of the olecranon.

Fig. II. *f* is an abnormal ligament connected with *b* superiorly. Between the fork formed by the divergence of these ligaments a small pencil can be passed. This ligament is inserted into the greater sigmoid cavity, and may be due to the inflammatory action of Fig. I. *e*.

Fig. III. is a view of the radius and ulna from above.

b is a movable bit of bone which does not extend to the inferior surface of the olecranon, but is chipped off.

c is that part of the internal lateral ligament which extends from the olecranon to the coronoid process.

d represents the coronoid process fractured at its

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base. It is united to the ulna by ligament, which allows motion antero-posteriorly to the extent of 5 mm. The fracture is serrated in the half toward the radial side. The fracture was detected while the capsular ligament was undisturbed.

A comparison of sections of this process in the normal state shows that in this case it is not abnormally prominent. For an additamentary fragment of bone which increased the height of the coronoid process, *vide* R. Adams.* This case simulates fracture, but was the result of chronic rheumatic arthritis.

e represents fissures of the olecranon showing partial fractures.

r, Figs. II., III., IV., represents the head of the radius much misshapen. The point nearest to the coronoid process, Fig. IV. *a*, dips toward the shaft of the radius.

Fig. IV. *n* represents the normal size of the head of a radius, which I find, from an examination of a large number of specimens, is 2 cm.

r is the head of the radius in this specimen, the diameters of which vary.

$a\ b = 3.5$ cm., $c\ d = 2$ cm. $+ 3$ mm., $e\ f = 1.5$ cm.

A few days ago it occurred to me that as there was half an inch shortening, and one end of the head of the radius dipped toward the shaft, the chances

* A Treatise on Rheumatic Gout, p. 181.

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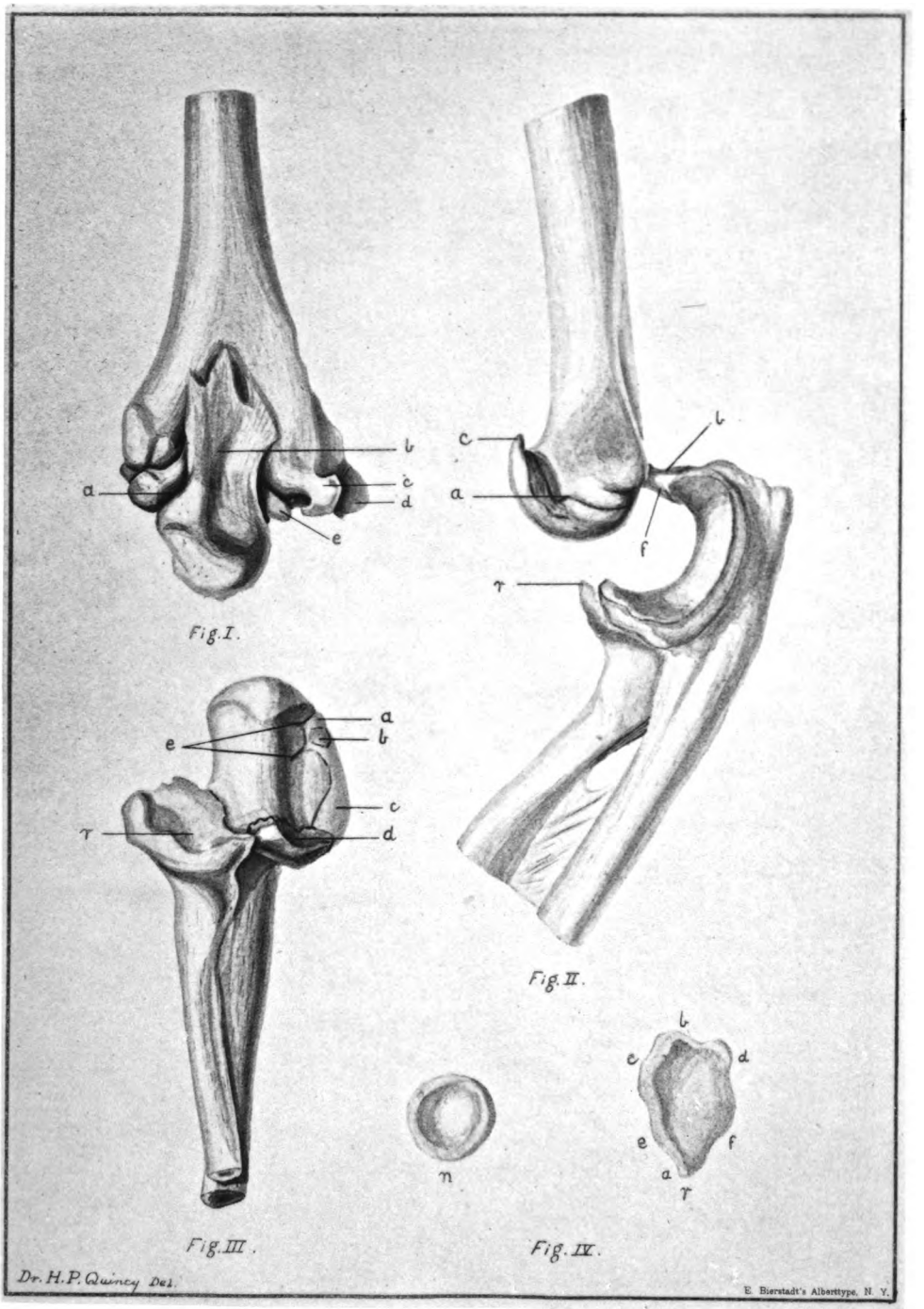

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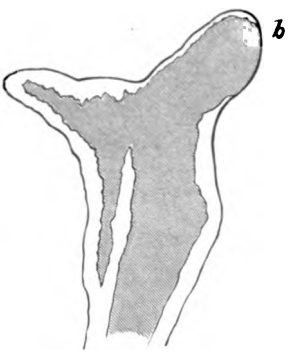
were that there was an impaction of the neck of the radius. A section was made in the axis of the bone, and it showed that such is the case.

The impaction is on its anterior surface. The thickness of the compact tissue of the upper and the lower sides of the radius does not present any marked difference in normal specimens.

The spicula of compact tissue which is seen in the drawing was at one time on the exterior of the bone. Cancellated tissue exists on each side of the projection. Impaction alone could produce this result.



a is the anterior extremity near the coronoid process.

I can find no mention of this form of fracture in the upper end of the radius in any surgical writers, and think that it has not been described. Malgaine * figures an impaction of the lower end of the radius, which in appearance somewhat resembles the above figure.

* Atlas, Pl. X. Fig. 7.

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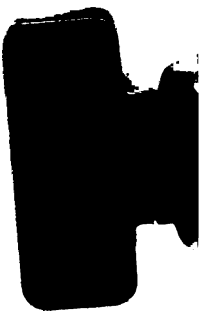

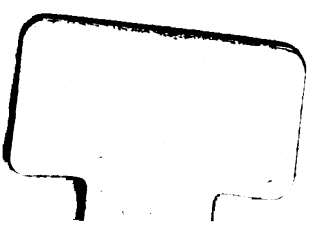

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